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ABSTRACT

This paper addresses the conditions under which quantitative and qualitative research methods could be combined in special education. The paper asserts that qualitative designs have not had a significant effect on special education research and speculates that mixed-method research might be more acceptable to special education researchers or editors than studies using only qualitative methods. The methodological characteristics of each approach to research are described. Strategies for mixing quantitative and qualitative research methods are discussed. The work of Robert Yin, who has described ways in which quantitative data can be embedded in case studies, is examined. The use of mixed-methods in educational evaluation is addressed, and the special case of single-subject research is analyzed. Several examples of the integration of qualitative and quantitative methods are then described. The paper concludes with a discussion of the need for and viability of mixed-method research in early intervention. This conclusion argues that mixed-method research is needed for both philosophical and pragmatic reasons, but that it is important not to let mixed-method designs excuse researchers from following the principles or rules of each method. Mixing methods generates the possibility of creating a higher standard of research which would take into account the complexity of the organism, the environment, and the intervention, as well as different perspectives on the purpose of research. (Contains approximately 65 references.) (JDD)

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Mixed Method Research in Special Education

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Mixed Method Research in Special Education

A review of the classic text by Rombauer and Becker (1975) suggests that apples and oranges do not, in fact, mix. Special education research has been largely confined to quantitative studies (Stainback & Stainback, 1984); investigators have, by and large, ignored the criticisms of proponents of qualitative research. This paper addresses the conditions under which quantitative and qualitative research methods could be combined in special education. Mixed-method strategies have been called combining methods (e.g., Bifano, 1989), integrated methods (Sprague & Zimmerman, 1989; US Office of Technology Assessment, 1980-81), multimethod design (Durst & Schaeffer, 1987), multiple methods (Mark & Shotland, 1987; Shotland & Mark, 1987), triangulation (e.g., Denzin, 1979; Goetz & LeCompte, 1984; Kidder & Fine, 1987), imbedded strategies (Yin, 1989), eclectic methods (Beauchamp & Braden, 1989), complementary methods (Firestone, 1987), and quasi-ethnography or microethnography (Goetz & LeCompte, 1984). Yin (1989) used additional terminology, which will be discussed in the case study section later. The large number of labels belies the limited extent to which qualitative and quantitative methods have been mixed in educational research.

To determine how often mixed-method research was published, recent ssues of the Journal of Early Intervention (JEI) and Exceptional Children were examined . The investigation began with the 1987-88 volumes of each journal to discover current trends in published research. Each research article was coded as using quantitative, qualitative, or a combination of methods.

Table 2 shows that three mixed-method studies were published in JEI and five in Exceptional Children. Interestingly, in each journal, the preponderance of mixed-method studies was reported in a single year, 1988-90 for JEI and 1989-90 for Exceptional Children. Considerable variability was noted in the total number of research studies reported in each volume, ranging from 19 to 29 in JEI and 18 to 40 in Exceptional Children. In conclusion, although Stainback and Stainback anticipated a pendulum swing away from quantitative research in special education, the literature suggests they may have been premature.

Research in special education as a whole and in early childhood special education is predominantly quantitative, with an emphasis on statistical investigations. About half as many studies consisted of descriptive quantitative information, and about half that number involved single-subject design or visual analysis. Special education researchers who specialize in the latter designs are, however, likely to publish in journals such as the Journal of Applied Behavior Analysis and Analysis and Intervention in Developmental Disabilities, which are almost exclusively devoted to this type of research. Thus, the figures for single-subject/visual analysis may represent the extent to which these designs appear in the mainstream special education journals rather than the extent to which this type of research is actually conducted. The paucity of qualitative research in the two journals examined shows either how little such studies are conducted or the reluctantance of editors to accept these reports. Since there is probably bidirectional causal effect

(i.e., research methods are influenced by publishability, and publication decisions are influenced by reviewers' familiarity with the research method), it must be concluded that qualitative designs have not, by and large, had a significant effect on special education research.

The three mixed qualitative and quantitative studies were accepted by JEI in 1988-1989. Exceptional Children, on the other hand, has published all five of its mixed-method papers in 1990-1991 and has no qualitative-only studies in that time. It can be speculated that mixed-method research might be more acceptable to special education researchers or editors than studies using only qualitative methods. It is too early to tell whether there is a trend towards fewer purely statistical reports and more mixed-method designs; the ratios are still heavily weighted on the quantitative-only side.

The Paradigm Question

Special education research reflects a historical adherence to the traditional view of what constitutes reality. The "paradigm wars" (Gage, 1989) that have raged in educational research have also been fought on the special education battleground--Exceptional Children. In 1984, Stainback and Stainback called for a broader research in special education, specifically for more a more qualitative approach. Simpson and Eaves (1985) countered by suggesting that, in essence, special education should have no excuses like this for "refusing to quantify our results" (p. 328). In response, the Stainbacks' two primary points were that (a) it is inappropriate to judge the

value of one paradigm from the perspective of another, and (b) special education should not limit itself to one way of searching for knowledge (Stainback & Stainback, 1985). In this section, the quantitative and qualitative approaches to research are briefly described, as are the methodolgical characteristics of each.

The Quantitative World View

Traditional research is based on the philosophy that we can study phenomena from an external point of view in an objective manner. To a certain extent, there is an assumption that reality is static, that phenomena can be captured whenever they are measured and that such measures are transferable to other times. The following description is based on Merriam's (1988) characteristics of quantitative research. Most notably, the focus is on quantity, with an emphasis on experimentation, empirical rules, and statistical analyses. (Behaviorism, a highly empirical world view, does not, however, traditionally employ statistics.) In order to test hypotheses about how the world works, the research is predetermined and highly structured. Settings may be familiar or not and sometimes are artificial, especially in experimental research. In order to maximize the generalization to the population not in the study, sampling often involves using large numbers, random selection or assignment, and representative subjects. Data collection is designed to be as objective as possible, using validated instrumentation.[2]

[2]To claim that data collection consists of "inanimate instruments" (Merriam, 1988, p. 19), compared to the researcher as the data collection agent in qualitative research, is to

Finally, quantitative research analysis is primarily deductive, using statistical methods (applied behavior analysis excepted). Descriptive studies consisting only of means and standard deviations (see Table 2) are not commonly thought of as statistically analyzed; the researcher analyzes the relationships according to "clinical" significance.

Finally, Merriam (1988) may reveal a bias in her characterization of quantitative research findings as "precise, narrow, reductionist." Certainly, they are confined to the phenomena measured, but certain quantitative models, such as multiple analysis of variance, multiple regression analysis, and aptitude-treatment interaction models, can involve a large number of variables, including so-called qualitative variables. The findings are only reductionist in comparison to the potential breadth of findings in qualitative research. Merriam's characterization of qualitative findings as "comprehensive, holistic, and expansive" (p. 19) is based on the assumptions that the researcher (a) can capture all the dimensions of the phenomena through the data collection techniques employed, (b) can write about all these dimensions in a coherent report, and (c) can interpret all these dimensions for their educational or psychological relevance.

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ignore the human factor in observational coding. Because observers are trained to code behaviors the same way (interobserver agreement) does not diminish the human factor involved in quantitative data collection. Reliability between humans is, after all, one of the major challenges of traditional observational research.

The purpose of quantitative research is to determine relationships, effects, and causes with a focus on individual variables. While qualitative researchers try to account for the effects of preconceptions and expectations on the outcomes, quantitative researchers try to control for such effects by systematically designing the study ahead of data collection, statistically testing the data against the null hypothesis, and eliminating sources of treatment contamination (Goetz & LeCompte, 1984). Generally the study is context-free, thus enhancing generalization. In psychology, quantitative analysis stands in marked contrast to traditional cognitive research, where the intrapsychological properties of behavior (process variables) have been conducted often with little regard for content and context (Proshansky, 1976; Schoggen & Schoggen, 1984). In environment-behavior research, the behavior setting survey (Barker & Wright, 1975) is the principal quantitative method for studying the impact of the "locus" on molar behavior, with no regard for intrapersonal effects. Schoggen (1978) has called this "the psychology of the absent organism" (pp. 48-49).

Positivists have claimed that their type of research eliminates bias, does not involve the researcher's emotional involvement, and moves beyond common-sense beliefs (Smith, 1983a). In contrast, the qualitative paradigm involves a belief that bias cannot be eliminated, that the researcher's emotional involvement is advantageous, and that ideas should emerge from the data.

Quantitative Research Principles

Quantitative research requires maximizing the objectivity of data collection. In order to show that the findings are not serendipitous, replicability is paramount, leading to an emphasis on reliability and minimizing threats to internal validity. In the scientific quest for discovering what is true, the quantitative researcher attempts to prove that others would see the same phenomena (interrater/interobserver agreement) with similar subjects (sampling). In an experimental study, the researcher attempts to present the intervention in such a way that others could replicate the experiment (reliability). Seeing the same phenomena requires instrumentation that controls for individual characteristics of the researcher. Analysis in statistical designs is directed at showing that the effects observed (dependent variables) were related to the groups or interventions (independent variables) rather than to chance. The further the findings fall outside the range of probability that the phenomenon occurred by chance, the more robust they are. Hence the importance of p values, preferably less than .05, and r values, preferably greater than .39. These purport to show that the null hypothesis (the likelihood of no effect) is rejected.

For statisticians, some of the most important rules are related to the assumptions that must be met in order for a given statistical procedure to be valid. Thus, researchers might be concerned with normal distribution of the data, collinearity, homogeneity of variance, equal or unequal numbers in each "cell," and so on.

In observational studies, the quantitative researcher attempts to remain "outside" the phenomenon by operationally defining the actions of the subjects. This attempt to specify the parameters of behavior has been criticized for restricting coding to the adequacy of the operational definition. Thus, when coding a child's attending behavior, for example, the researcher might only count the child's "eye gaze directed at the object presented or person speaking." With such a definition (usually, they are considerably longer), the child who gazes out the window pensively during story time, even though laughing and smiling at the appropriate places in the story, would not be coded as "attending" to the story. This inadequacy of the operational definition has given rise to a new concept for defining behavior, known as the "paradigm case study" (Matthews & Matthews, 1982). Here, no operational definition is provided, but the observer is instructed to code the behavior if it is an example of the category (e.g., attending) as he or she knows it. The principle is that the observer can include the wide diversity of behaviors that fit into the category being coded. It also allows the observer to exclude those behaviors that might have fit the operational definition but, subjectively, are clearly not examples of the category under consideration. For example, the child who stares blankly at the adult during story time, without reacting, as though day-dreaming, would be coded as attending under the operational definition. Using the paradigm case study, the observer could assess the totality of the child's behaviors and code the child as not attending. The paradigm case study has

shown initial success in interobserver agreement (Matthews & Matthews, 1982). This appears to be an example of a rapprochement between the quantitative principles of positivist inquiry and the qualitative principles of phenomenological inquiry.

The Qualitative World View

Ethnography, as one qualitative research model, depends on the description and understanding of cultures (Chiang, 1989; Smith, 1983b). It should not be confused with the more general paradigm that may or may not be related to "the culture." Ethnography involves finding meaning in a "grounded" study of a culture (i.e., one that is "close to" the data). Hermeneutic understanding (Weber's, 1977, Verstehen), central to this paradigm, is the science of interpretation (Bleicher, 1980, 1982), and is based on the relationship between parts and the whole, such that it is context-bound (Dilthey, 1985). The term "hermeneutics" is derived from Hermes, the Greek messenger god with the winged feet whose job was to take divine messages and interpret them to humans (Palmer, 1969). Chiang (1989) laments that the researcher's presence and his or her interpretation of the events (the message) provides the reader of research with a picture that might not have been reality from the subjects' perspective.

Goetz and LeCompte (1984) have described research assumptions as having the following dimensions: induction to deduction, generation to verification, construction to enumeration, and subjectivity to objectivity. Ethnography tends

towards the inductive, generative, constructive, and subjective, in contrast to experimental modes, which tend towards the opposite ends of these dimensions.

The personal process of qualitative research includes heuristic (insightful) approach to research (Moustakas, 1967, reprinted in 1981). In both heurism and hermeneutics, the experiences and reactions of the individual researcher are important. Some researchers have claimed that the researcher's involvement in the setting and with the subject has led to the Heisenberg Uncertainty Principle (Goetz & LeCompte, 1984; Guba, 1981; Guba & Lincoln, 1982; Keutzer, 1984; Lincoln & Guba, 1985; Patton, 1980). This principle states, essentially, that observers, by their very presence, have an effect on the observed, thus rendering the observations invalid. It appears, though, that this principle has been erroneously borrowed from the physical sciences (McKerrow & McKerrow, 1991). It was developed from quantum mechanics, where statistical probability had to be employed when it was discovered that either the position or the momentum of a particle could be accurately measured, but not both simultaneously (Hawking, 1988). It is not the observer's presence that makes simultaneous measurement impossible, but the relation of position to momentum. McKerrow and McKerrow thus conclude that, "arguing that the Heisenberg Uncertainty Principle replaced subject-object dualism [the observer's presence changing the phenomenon observed] with mutual interactivity or inseparability is an erroneous claim" (p. 19).

Traditional research, by following its own rules, maintains the status quo (Argyris, 1980), whereas action research, for example, defines the boundaries of "new paradigm research" (Allender, 1986):solving problems through qualitative research in the relevant context. Aspects of the old paradigm to which the nontraditional methodologists objected ten years ago included its positivism, reductionism, reification, undue emphasis on quantification, deception, debriefing, and determinism (Reason & Rowan, 1981). They were principally concerned with personal integrity and social values. Value judgments are not only allowed in qualitative educational research and evaluation, they are encouraged (Wilson, 1983). Howe (1985) argues that, without value judgments, the findings are likely to be useless, inefficient, or harmful.

In the qualitative paradigm, statistical significance tests are considered misleading, and more generalizable information is likely to come from case studies (Carver, 1978). Behaviorism likewise is seen to be philosophically flawed because of its denial of qualitative data (Howe, 1985). Qualitative apologists consider the omission of grounded data as "succumbing to the 'tyranny of reliability' (Messick, 1981). Reliability does not by itself reduce fallibility regarding the question of interest" (Howe, 1985, p. 14). At the beginning of a study, for example, selecting subjects in ethnography is more concerned with comparability and translatability to other populations than inference to the nonsample population (Goetz & LeCompte, 1984).

The lexicon of qualitative research may be no less arcane to positivists than statistical jargon is to nonempiricists. Merriam (1988) defined the case study with the following four terms. Particularistic means the research focuses on a specific problem, group, phenomenon, person, and so on. Descriptive includes the use of what anthropologists call "thick description," where narrative accounts are used to document what occurs. Heuristic means that meanings and insights of the phenomena are presented for the reader. Inductive means that hypotheses emerge from the data; even if the researcher begins the study with certain expectations, they might be rethought as the data are examined during the study. Qualitative research has also been characterized as grounded and holistic (Guba & Lincoln, 1981). Perhaps the primary distinction between the qualitative and quantitative world views is that the former consists of how all the parts of a phenomenon work together, while the latter consists of measurement of certain parts (variables) of the phenomenon.

Although both types of research have their linguistic codes, the language used in qualitative reports stands in contrast to the neutral, scientific language used in positivist research writings. Smith (1983a) has denounced the idea that the latter type of language provides a more valid picture of reality.

Howe and Eisenhart (1990) conclude that standards for qualitative research must not be established so as to force this paradigm into the position of the bipolar opposite of positivism, since that position would ackowledge the dominance of positivism

as the standard bearer for such concepts as objectivity, the outsider's perspective, and so on. "Refusing to entertain positivism as a viable epistemological doctrine--a refusal that is now univocal within the philosophy of science--is how to avoid this procrustean bed [the assumption that qualitative research must coexist with positivism]" (p. 8).

Qualitative Research Principles

Qualitative research requires an inductive, subjective, generative, and constructive approach to data collection (Goetz & LeCompte, 1984). That is, the concept of reality is ever-changing, knowledge consists of understanding, and the goal is to examine the process (Reichardt & Cook, 1979). Qualitative research has borrowed principles extant in phenomenology, symbolic interactionism, and ethnomethodology (Bogdan & Taylor, 1975). Data collection techniques tend to be multimodal with the researcher's acknowledging his or her personal outlook on the phenomenon. The concept of validity is entirely different from the empiricist's; it relies heavily on description, either through the observer's report or through quotations from subjects, and the researcher's analysis. The reader is expected to make an independent judgment about the validity based on the emic (vs. etic) logic and the thickness and richness of description. The emphasis is on process variables. The principles of qualitative data collection are therefore that it be naturalistic (often field-oriented), holistic, eclectic (hence the heavy use of triangulation), long-term or repeated, personal,

interpretive, descriptive, hermeneutic (focused on meaning), and grounded.

The Place for Both World Views

In Gage's (1989) futuristic look at the paradigm wars, researchers in the 1990s discovered that upholding one paradigm did not inevitably mean having to defeat another and that qualitative and quantitative methods were not incompatible. In this fantasy, many studies after 1990 employed both objective-quantitative and interpretive-qualitative methods. "Indeed, most of these investigations with both kinds of methods turned out to be more fruitful of insights, understandings, predictive power, and control resulting in improvements of teaching" (p. 7). He surmised that, if the wars continue, it may be because researchers accept psychological differences between the objectivists and the interpretivists, with the former labeled tough-minded, scientific, and statistical, and the latter labeled tender-minded, humanistic, and clinical.

Howe (1985) discusses disjunctive and conjunctive combinations of qualitative and quantitative methods. Disjunctive combinations consist of using (a) data collection techniques from one paradigm to study one phenomenon or outcome and (b) techniques from the other paradigm to study another phenomenon or outcome. Conjunctive combinations use data from both traditions to investigate the same issue. Conjunctive combinations may be too much of a compromise for some researchers who would be comfortable with disjunctive combinations (e.g., Smith, 1983a, 1983b).

Rigid definitions of the paradigms (quantitative = facts, objectivity, fixed categories, the outsider's perspective, static reality, causal explanation; qualitative = values, subjectivity, emergent categories, the insider's perspective, fluid reality, understanding) may lead to accusations of a procrustean bed when methods are combined (Howe & Eisenhart, 1990). Purists would argue that the standards of one paradigm are stretched or shrunk to fit the alternative paradigm. This is especially likely from the positivist camp, where methodological rigor could be compromised when trying to absorb qualitative methods. Purism in qualitative research is exemplified by Rist's (1980) fear that researchers untrained in the ethnographic method would adopt some of its strategies, reducing time spent in the field and otherwise abusing its principles, and produce blitzkrieg ethnography.

As changes in the standards of quality research (Allender, 1986) are made because of a greater acceptance of both paradigms, proposals for integrating methods have emerged. Within qualitative research, for example, Herriott and Firestone (1983) have suggested repeating a study in different types of settings to improve generalizability. A more common recommendation is to plan, in a study, an experiential stage to generate hypotheses, followed by traditional quantitative methods (e.g., Price & Barrell, 1980)

The pervasiveness of personalization by the researcher in certain types of qualitative research is demonstrated by Riebel's (1982) case studies of Adler and Freud, where he showed their theories to be "a kind of self-portrait" (Allender, 1986, p.

184). Their scientific constributions tell us as much about their own personalities as about the human condition.

The broad field of environment-behavior research (Schoggen & Schoggen, 1984) is a likely venu for mixed-method research. In fact, Proshansky (1976) has contended that the simple relationship between stimulus and response is unacceptable in this approach, which is concerned with person/physical setting effects. A distinction is made between behavior systems reactions and psychological system reactions. The former is measured by people and instruments, without the subject's knowledge. The latter is measured with full awareness by the subject.

Strategies for Mixing Methods

The positivistic tradition of quantitative research and the hermeneutic tradition of qualitative research have spawned different but sometimes complementary data collection methods. Yin's (1989) concept of the case study, recent strategies for conducting educational evaluation, and single-subject research may be considered special cases that shed light on the importance of integrating methods.

Methodological Characteristics of Quantitative and Qualitative Research

Quantitative data collection methods stress objectivity, reliability, validity, and quantification. Qualitative methods stress induction, subjectivity, consistency, understanding, and description. Table 3 lists data collection strategies in education from both traditions, cross-referenced for examples of

overlapping strategies. The table also shows how various methods within traditions have been combined. From this analysis of the literature, existing quantitative records (test scores, attendance records, etc.) and surveys are the quantitative strategies most often integrated with qualitative methods. Interviews and case studies have been the most common qualitative methods to be imbedded with quantitative data. Observational research yielding both quantitative data and narratives have been used in mixed-method designs. Robert Yin (1989) has described a number of ways in which quantitative data can be embedded in case studies.

Yin's Case Study Research Model

Yin (1989) has defined the case study as

> an empirical enquiry that:
> - investigates a contemporary phenomenon within its real-life contex; when
> - the boundaries between phenomenon and context are not clearly evident; and in which
> - multiple sources of evidence are used (p. 23).

It is primarily described as a qualitative approach, but it can "include, and even be limited to, quantitative evidence" (p. 24). He designates the use of more than one unit of analysis as an embedded strategy, where quantitative data can be combined with qualitative data. Experiments, surveys, archival analyses, other forms of documentation, life histories, participant observations, direct observations, interviews, or physical artifacts in some combination within the case study are examples of multiple sources of evidence. The "analytic strategy" (p. 109) is a specific method for such combinations, in which pattern-matching,

explanation-building, and time series techniques are used to develop internal and external validity within and across case studies. Pattern-matching involves comparison of predicted data with actual data, and explanation-building involves a series of iterative steps, leading to a concluding explanation for the data gathered. Time-series analysis involves the analysis of data over time, using a single-subject research design. The critical point is that the researcher is studying a single phenomenon--the case. The data used to describe and explain the case can be either quantitative or qualitative in nature. Yin has described this model for research, but educational evaluation has embraced the mixed-method design perhaps even more enthusiastically.

Mixed-Method Evaluation

Educational evaluation is conducted for decision-makers who are not necessarily researchers nor even educators. The combination of quantitative and qualitative evaluation methods has provided the type of information that appeals to empiricists and nonempiricists alike. Patton (1980) has articulated that, although systems analysis and the behavioral objectives approach to evaluation are incompatible with a phenomenonological perspective and a naturalistic inquiry method, quantitative and qualitative data-gathering can go on at the same time. He argued, however, that incorporating qualitative data changes the pure systems analysis or behavioral objectives model: "qualitative methods do not fit" (p. 51). He did not, however, maintain the purist expression in his classic book on qualitative evaluation and admitted that in actuality methodological mixes

may be called for. For example, it is possible to collect qualitative data from randomly assigned subjects and to analyse quantitatively the content of descriptive or normative data. He provides examples of mixed designs. In general, he argues that the purposes of evaluation may call for both phenomenological and positivist information.

Mixed-method designs in educational evaluation were studied by Greene, Caracelli, and Graham (1989). They first analyzed the purposes given by the authors of the original studies for using this mixture. From 18 published evaluation studies, 17 evaluation reports, and 22 evaluation papers, they grouped the primary and secondary purposes into five categories: triangulation, compelementarity (e.g., seeking elaboration for the same research question), development (e.g., using the results from one method to develop a study using the other), initiation (e.g., looking for contradiction), and expansion (e.g., using different methods for different research questions). Triangulation, expansion, and "not stated" were each cited in approximately 25 percent; the remaining three purposes were cited in the other 25 percent. When these investigators analyzed the studies in terms of their own definitions of how the mixed methods were used, however, only three used them for triangulation, 18 for complementarity, seven for development, 2 for initiation, and 27 for expansion. They concluded by providing a "funnel array of recommended design options" (p. 269) in the order presented above. Thus, mixing methods for triangulation purposes provides the most constrained and narrow

options for flexibility in the design, and expansion the most open and wide options. In assessing qualitative and quantitative integration in data analysis and interpretation, they found that nearly equal numbers of studies achieved some degree of integration as did not. That is, half the studies reported quantitative and qualitative results separately.

Single-Subject Research: A Special Case

Surprisingly absent from the literature is the common ground shared by qualitative proponents and applied behavior analysts in indicting statistical analysis. Both traditions emphasize the importance of the individual. Qualitative information provides a holistic picture, replete with inductive explanation for the findings. Applied behavior analysis (ABA) provides many data points (usually from direct observation) on a narrowly defined behavior most often from one individual at a time. Qualitative people criticize statistical analyses as too narrow, whereas applied behavior analysists condemn their breadth.3[3] Nevertheless, both groups would agree with Disraeli's famous retort when confronted with complex data in a parliamentary debate: "Lies, damned lies, and statistics."

Yin's (1989) inclusion of time-series analysis as a component of the analytic strategy thus connects qualitative and ABA methods. In time-series analysis, the researcher might

[3]The case against statistical testing has also been articulated by Carver [1978], who challenged the assumptions underlying (a) interpretation of the p value as caused by chance, (b) statements that statistically significant findings represent "reliable differences," and (c) claims that the hypothesis is supported when statistically significant results at the .05 value are found.

collect data from a single case at a time. More than one case can be included in the multiple-baseline design, where experimental control is demonstrated by no change in the baseline for one subject while, at the same time, another subject receives the intervention. The multiple-baseline design can also be used for one subject across different behaviors, settings, and so on. The data are collected over time (hence time-series) and displayed in a graph with time along the x axis and the outcome measure up the y axis. The principle of single-subject research is that close analysis of intervention with one or a very few subjects can produce generalizable findings. Generalizability in ABA rests on highly particularized definitions and procedures that are replicable by others. Reliability, especially interobserver agreement, is important for replicability and is calculated by a number of formulae, such as the exact agreement formula, kappa, phi, the generalizability coefficient, or a correlation coefficient. In the qualitative case study, however, replicability is not a priority, and therein lies the critical difference between these two forms of single-case research.

The Problem of Compromise

To what extent can one collect data both qualitatively and quantitavely without violating the principles described above? Whether one should even attempt to do so is both a philosophical and a practical consideration. The researcher who undertakes an essentially quantitative study might wish to include qualitative information to compensate for the dryness of the information gathered using traditional techniques. For example, in addition

to surveying early childhood special educators about the success of mainstreaming, the researcher becomes a participant/observer in a mainstreamed preschool. The qualitative principles would be violated if the researcher (a) spent too little time observing, (b) did not keep field notes, (c) remained apart from the children and staff, (d) only recorded behaviors he or she had decided ahead of time to document, (e) did not interpret what was seen, or (f) did not acknowledge any biases related to the topic he or she might have.

Similarly, the researcher who pursues an intrinsically qualitative study might want to include quantitative information to increase the generalizability of the findings. For example, in addition to conducting in-depth interviews with children, families, and staff members as well as observing in classrooms, the researcher might also have an associate observe with a coding scheme. The quantitative principles would be violated (a) if the formal observation did not include interobserver agreement data, (b) if the operational definitions included subjective elements, (c) if it was not made across enough subjects (when statistics are used), (d) if the coding scheme consisted of intervals that were too long, (e) if competing variables were neither measured nor controlled for, or (f) if the discussion on the formal observations strayed too far from the data. Violations (a) and (b), in all likelihood, would occur together. If the categories allow for coder subjectivity, interobserver agreement is difficulty to achieve.

The problems with compromising on qualitative or quantitative methods or both are discussed from an epistemological framework later in this paper. The premise here is that a study with claims that the findings are extrapolated from a given method or methods must be consistent with the principles of that method. The researcher also has the option of using one method, from which the results and interpretation are derived, and adding elements of the other method for illustration only. In this case, the formal findings must be able to stand on their own (i.e., sound methods were used), and the researcher cannot claim that the illustrative information provides new information nor confirmatory evidence. In this case, the illustrative information is most appropriately presented in the discussion rather than the results section.

Examples

In order to illustrate the integration of qualitative and quantitative methods, __ studies are described. The purposes, methods, and analyses are emphasized, rather than the results.

Bower, Anderson, and Thompson (1987) presented a large-scale, multisite, "multimethod" (p. 1) evaluation of preschool intervention projects for children with disabilities and those at risk. The study had four phases. The first involved a prefatory naturalistic study including case-study methodology, extensive observations, and personal interviews with staff and parents. The second phase involved "applied qualitative methodogy," consisting of multiple-choice questionnaires, an environmental rating scale (Harms & Clifford, 1980), and surveys. The third

phase involved observations in a stratified random sample of classes, interviews, and field tests of surveys and questionnaires. The final phase involved surveys, qualitative interviewing strategies, a group interview to complete an interagency case study, other case studies, observations, performance data on over 600 children, and profiles of more than 300 classes. As a result of using the mixed method approach, the researchers were able, in the final phase, to "identify issues that had not surfaced during the preceding phases of the study, ... [investigate] these issues via a core of qualitative interview questions, [and secure] triangulation using a representative sample of data sources" (p. 10). In their rationale for using a mixed method design, Bower et al. cited (a) Smith's (1986) assertion that it would diversify bias ("the whole is greater than the sum of the parts," p. 37), (b) Sieber's (1973) note that quantitative findings can augment the findings of qualitative research, and (c) Patton's (1980) "ebb and flow" (p. 185), when the researcher can move between openness to new data inputs and testing explanations.

Salisbury, Britzman, and Kang (1989) set out to assess the social-communicative competence of young children and "to examine the utility of participant observation methodology" (p. 154). The third author, who had served as the participant observer, content analyzed (Guba & Lincoln, 1981; Lincoln & Guba, 1985) her field notes, and the other two authors validated the proposed shared themes by re-examining the field-note data to establish reliability. After this qualitative data collection, the

researchers used quantitative methods for analysis, establishing reliability, and reporting the findings. They coded the field notes with predetermined, operationally defined categories and determined interrater agreement. The results were reported in terms of grounded themes (qualitative) and categorical findings (quantitative); the latter consisted of mean levels of responding by the six children in terms of the communication categories. The authors recommended combining participant observation with formal assessment data to determine the child's capabilities. The grounded data provide information about the context that should result in intervention goals that take into account the child's interests and motivation, according to the authors. [RESULTS?] This study shows how a priori operational definitions (a quantitative concept) can be used to code anecdotal records (a qualitative tool).

Whereas Salisbury et al. (1989) combined participant observation and categorical coding, Case-Holden and Hupp (1989) mixed a case study methodology with a single-subject design. They gathered information on a single subject through medical histories, reports by familiar adults, and observation. The purpose of the study was to reduce stereotypic handmouthing by the child. Once the problem was verified, providing something of an informal baseline, an alternating treatments (water play and vibration as reinforcers) design was developed. This applied behavior analysis was conducted according to traditional operant conditioning guidelines. The results were presented purely in quantitative fashion, based primarily on visual analysis (graphed

data). This study thus included an empirical description of the subject, the environment, and other relevant factors in the context of a case study (a principally qualitative method), where the "case" was the intervention rather than simply the child's story.

Capper (1990) used qualitative research methodology in a descriptive study of students with low-incidence disabilities in disadvantaged, rural settings. Participant observation, informal interviews, observation, demographic data questionnaires, and document analysis were used to collect data. Validity was ensured through multiple sources of evidence, chain of evidence, and investigator triangulation (Yin, 1984). The researcher addressed reliability through documenting the procedures and "creating a case study data base (Yin, 1984)" (p. 340). Three children with severe disabilities were continuously observed for one school day each. The replication across students and across sites (each child attended a different school) presumably addressed validity, yet the data on how time was spent indicated considerable differences among the subjects and sites. The investigator's aim was to assess the impact of special education policy on the school day, so the results are provided according to "the product of policy" (time-spent data) and patterns that emerged from the multiple data sources. These patterns consisted of a shortage of expert personnel, the weak political power of poor families, and a lack of positive examples of service provision. Capper acknowledged both the inability to generalize from her three subjects and the very short observation time. The

mix, then, in this study consisted of qualitative data collection techniques and quantitative descriptive data on how time was spent.

In a study of the impact of training consulting teachers, Gersten, Darch, Davis, and George (1991) used semi-structured interviews and participant observation. Eight consulting teachers (trainees) and 70 classroom teachers participated. The interviews were conducted with the classroom teachers, and the results were reported in terms of percentage of teachers reporting various functions of the consulting teacher. Chi-square analysis was used to discern differences between experiences with trained and untrained consulting teachers. Furthermore, the quantification included assessing interrater agreeement. The classroom teachers' evaluations of the consulting teachers was also quantified, and t tests were run. Finally, the percentage of each type of activity performed by consulting teachers, as determined by analysis of the observational records, was reported. The observations lasted from five to nine days with each consulting teacher. The results also included information from the field notes of the participant observers, with two verbatim examples of two paragraphs in length. The authors write about the "limitations of a small-scale study such as this"--a statement that can only be made from a quantitative standpoint. Yet this could be considered an example of true mixed-method research; both the qualitative and quantitative methods were implemented according to standard principles for these two types of research.

Mercer and Denti (1989) studied efforts to integrate regular elementary and special education in a school where the two programs were in separate but adjacent buildings. They concluded that "two-roof" schools posed almost insurmountable problems to integration. The report consists of (a) observations by one of the authors who had extensive experience with the schools and (b) the results of questionnaires given to staff members. The questionnaires included reports of contacts with the other school, sociometric ratings of staff, and sociometric ratings of students. These data were analyzed for statistical differences between responses from the two schools. A disabilities-awareness intervention was described, and the impact was measured through an unspecified pretest-posttest statistical test. The short- and long-term effects were also described anecdotally. The intervention was reported to have produced pre-post increases. This study thus used a form of grounded research (observation based on experience) and statistical analyses of group differences.

"Are regular education classes equipped to accommodate students with learning disabilities?" asked Baker and Zigmond (1990). The method consisted of a case study design with an elementary school consituting the case. Data collection consisted of informal and formal observations, interviews, questionnaires, surveys, and document reviews. Three phases of observation were conducted. In the first (December, January), the observers took notes, following a protocol, on various dimensions of classroom activity. The second phase (January)

consisted of unstructured field notes on instructional activities, and the third phase (March) consisted of highly structured time-sampling observations of teacher and student behaviors. The teacher questionnaire was followed by open-ended interviews, in which the interviewers took field notes. Finally, questionnaires were administered to parents and students, and school records were examined. The qualitative data were analyzed for common responses, unusual responses, and patterns. The results combined information from both the grounded and the empirical data. Tables reporting the survey and the structured observation results were provided.

In an attempt to apply social construction theory to families' accommodation of developmentally delayed children, 102 families participated in semi-structured interviews (Gallimore, Weisner, Kaufman, & Bernheimer, 1989). This theory postulates that people construct "routines that sustain coherent and satisfying daily activities" (p. 216). In addition to the interviews, documents on the families were gathered and standardized scales were administered. The results of the standardized measures are reported separately from the interview results, which were treated as "case material" (p. 219). This report contained only a statistical description of the cohort characteristics. Representative illustrations and significant variations were reported from this large data set. In contrast to other case study researchers, **before data collection** Gallimore et al. compiled a list of ecocultural variables derived from the literature and case files from an earlier study. This list

provided the structure for the interviews and coding system. They argue that the statistical information alone does not detect the processes families use, and that the combination of discrete measures and case materials is needed to indicate the complexity of this construct. The case materials revealed that (a) the "sustainability" (p. 225) of daily routines is one of the best predictors of child and family outcomes, (b) constraints on family adaptation (i.e., their ability to sustain routines) may make an early intervention program unworkable, and (c) family routines of families with a child with disabilities are more alike than different from families with normally developing children, yet (d) the combination of child status and family impact creates a "hassle level" (p. 225) that makes differentiates families' abilities to make accommodations. This study exemplifies combinining the quantitative methods of large sample sizes and a priori categories with the qualitative methods of case study, deriving themes, and reporting narrative and verbatim accounts.

The review of the few mixed-method studies in special education and of the epistemological research lead to a conclusion that qualitative and quantitative data can be combined in a single study or project. Early intervention is a field where such a combination of traditions enhances the quality of research.

Conclusion: The Need for and Viability of Mixed-Method Research in Early Intervention

Mixed-method research is needed for both philosophical and pragmatic reasons. The individualized nature of early intervention with infants, toddlers, and preschoolers with disabilities calls for within-subject as well as between-subject investigations. The latter is, of course, the more traditional type of research. The heterogeneity of the population can cause problems in group research, which is one of the reasons for the large proportion of the variance that is inevitably attributed to error in statistical studies. The number of variables that can account for differences between subjects is enormous, including family characteristics, child characteristics, setting characteristics, characteristics of the disability, and history in intervention. The philosophical value of deductive research, however, is in generalization. Admittedly, generalization is a positivistic value that qualitative researchers can happily ignore. Since neither camp can lay claim to the one and only truth, the benefit of both perspectives of reality are inescapable. Quantitative methods will allow us to determine whether the relatively narrow phenomena we study in a given investigation have a greater-than-chance probability of having occurred. In a single-subject experiment, the quantitative data tell us whether the outcome occurred as a direct result of the intervention; probability estimates are generally of little concern. Qualitative methods, on the other hand, have less of a focus on outcomes, and give us a deeper and broader look at the situation under study. Since there appear to be good reasons for skepticism about all three methods, if we include applied

behavior analysis as a separate type of research, combinations within a single study are more likely to give us the full picture of the phenomenon.

Great caution is warranted, however. Laying aside for a minute the argument that mixtures are procrustean if not atheoretical, there is danger in compromising one or both methods for the sake of efficiency. We cannot afford to let mixed-method designs excuse us from following the principles (in quantitative research, the rules) of each method. The researcher who uses poor statistical analyses in the quantitative portion of the study, with the justification that the open interviews, for example, in the qualitative study make up for the quantitative deficiency, effectively destroys the credibility of the quantitative findings. Similarly, the empiricist who throws in a case vignette (i.e., a brief narrative about a single subject, setting, phenomenon, etc.) merely provides an example of the quantitative findings; the generative value of grounded research would be lost. Nevertheless--and here I concede some filtering of the above statements--sampling difficulties have dogged early intervention research. Large groups of young children with disabilities are generally not physically grouped together, and the movement towards less restrictive placements and the continuation of home-based services will exacerbate the difficulty. Since random assignment, for ethical reasons, can only occur between two or more types of acceptable intervention, rather than no-treatment control groups, the number of subjects available to be so assigned within a reasonable geographic area

must often be small. Therefore, otherwise well-designed quantitative studies will have reduced statistical power because of the sample size. Practically, the inclusion of qualitative methods can enhance such a study; whatever skepticism the reader might have could be offset by corroborative evidence from another paradigm.

Such acceptance of both paradigms is optimistically based on the assumption that the reader would value both deductive and inductive research. Again for pragmatic reasons, mixed-method researchers cannot get away with poor quantitative or qualitative methodology because of the risk that some readers will reject the findings from one of the methods anyway. The remaining method would need to be credible on its own. According to the reviews of articles in the Journal of Early Intervention and Exceptional Children, it appears that the positivist tradition still dominates, so quantitative methods will continue to be scrutinized carefully by reviewers, editors, and readers.

What of the emergence of qualitative research, either alone or in combination with quantitative methods? It is still new enough that the aphorism that a little knowledge is a dangerous thing applies. For example, some researchers include vignettes as examples of their quantitative findings, in the belief they are using qualitative methods. Others confuse qualitative variables with qualitative methods. Still others have overgeneralized what they have learned about qualitative research and believe that only participant observer methods qualify. Finally, the terminology, new to early interventionists and

special educators, is confusing; so, for example, all qualitative methods might erroneously be called ethnographic, whether they involve the concept of "culture" or not.

If we can mix methods, without diminishing our existing standards for either method, we have the possibility of creating a higher standard of research. It would take into account the complexity of the organism, the environment, and the intervention, as well as different perspectives on the purpose of research. "Perhaps the bottom line is that the qualitative findings provide the context of meanings in which quantitative findings can be understood" (Stainback & Stainback, 1984, p. 407).

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Table 3.

Overlapping Quantitative and Qualitative Strategies.

	Quantitative	Qualitative
Data-based	Records[1,3,8,9,10] Surveys[2,5,8,10] Questionnaires[6,8,10] Tests[6] Rating scales[8] Card-sort analysis[7] Time-series analysis[4] Cost-benefit analysis[15]	Interviews[1,7,8,9,10] Case studies[2,3,4,8,10,15] Participant/observer[5,8,10] Life histories[5] Voluntary informant[5] Essay questions[6] Retelling[6]
Theoretical	Records[11] Observation data[11,13,14] Data analysis[12] Questionnaires[12] Secondary data[12] Cost benefit/ effectiveness[12] Tests[12] Experimental designs[12] Probability samples[14]	Informants[11] Observation narratives[11,12,13,14] Interviews[12] Judgment/opportunistic samples[14]

[1]Lipset, Trow, & Coleman (1956)
[2]Larsen (1982)
[3]Yin
[4]Campbell (1969)
[5]Durst & Schaeffer (1987)
[6]Beauchamp & Braden (1989)
[7]Reynolds (1988)
[8]Bower, Anderson, & Thompson (1987)
[9]Fetterman (1989)
[10]van der Vegt & Knip (1986)
[11]McMillan & Schumacher (1984)
[12]Patton (1980)
[13]Stodolsky (1983)
[14]Jacob (1987)
[15]US Office of Medical Technologies (1980-81)